Mpeg-Dash System via HTTP2 Protocol with HEVC Encoder for Video Streaming Services

Dr.N.Nafea Kamiss[a], E.Mustafa Muhammed Awad[b]

[a] Research Director & Associate Professor of Communication Science, Information Engineering College
[b]Studentof master of communication Science,Information engineering College
E Mail:mustafa397@yahoo.com

Abstract: MPEG-DASH is an adaptive bitrate streaming technology that divides video content into small HTTP-objects file segments with different bitrates. With live UHD video streaming latency is the most important problem. In this paper, creating a low-delay streaming system using HTTP 2.0. Based on the network condition the proposed system adaptively determine the bitrate of segments. The video is coded using a layered H.265/HEVC compression standard, then is tested to investigate the relationship between video quality and bitrate for various HEVC parameters and video motion at each layer/resolution. The system architecture includes encoder/decoder configurations and how to embedded the adaptive video streaming. The encoder includes compression besides adaptive streaming, while decoder includes displaying of compressed video and the function of network sensing. The videos streaming is tested over two IP networks, Unicast and Multicast. A maps of network performance evaluation and how influences of different videos is achieved through sensors installed at main network nodes.
Keywords: MPEG-DASH, HTTP 2.0, Live latency, UHD, GOP, HEVC, Video Quality, PSNR

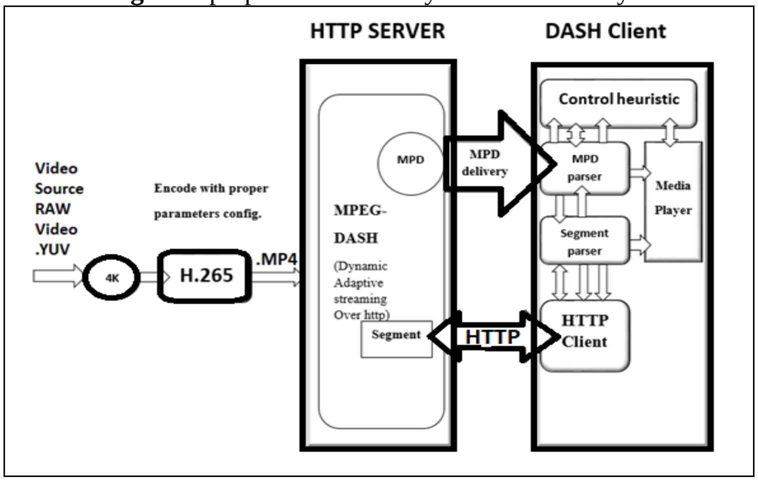
1. Introduction

Video streaming has become the main source of traffic in internet networks and is expected to represent about 80% of internet network traffic by the end of 2021 according to cisco [1]. The major goal of new video encoder generation is to enhance compression performance while maintaining good quality beside additional flexibility and advanced capabilities [2,12,17]. Compression techniques using layered H.265/HEVC encoders are the method to get the best of the traffic bandwidth load balancing due to the diversity of services and devices, as well as the growing demand for higher quality UHD video on the internet [3, 9]. The paper objectives include video compression and low-latency streaming adaptation, with the internet serving as a media communication channel for a wide range of end devices. The essential challenge is the available bandwidth, which is shared by an unbounded number of users. H.265 parameters have an immediate effect on the bit rate and quality of the video. The Hypertext Transfer Protocol (HTTP) protocol is used by OTT live streaming services over the public internet network [19] for live television. Despite the complexity of the end-to-end media pipeline and changes in network resources the controller at the client-side select suitable representation [4, 5]. Some solutions, such as HTTP Adaptive Streaming, try to adapt video content to network performance (HAS). HAS presents end-user-controlled video streaming delivery to dynamically adapt to changing bandwidth and viewing device characteristics. Globally standardized solution Dynamic Adaptive Streaming over HTTP (DASH) is an example of HAS implementations [7, 15].

2. Proposed MPEG DASH System for Streaming Video

The proposed system encoder consists of two-part, the first one dealing with encoder configuration while the second one is of server configuration of MPEG DASH. The main job of the first part is of finding the optimal operation of the HEVC stander at each resolution that keeps proper streaming of good quality. The second part is to install the server to work with MPEG DASH protocol to use the different resolutions that works based on channel condition. Such a system will serve the bandwidth reservation for video streaming with UHD resolution especially for widely usage Internet, also the unexpected number of users. Such case causes congestion in the network and rebuffering events. To eliminate this problem, the controller embeds in MPEG DASH at the client side, as shown in Figure 1, is used to avoid the congestion and rebuffering events when the network is loaded by instruction the encoder to selecting the proper layer.

Figure.1 proposed low latency MPEG-DASH system.

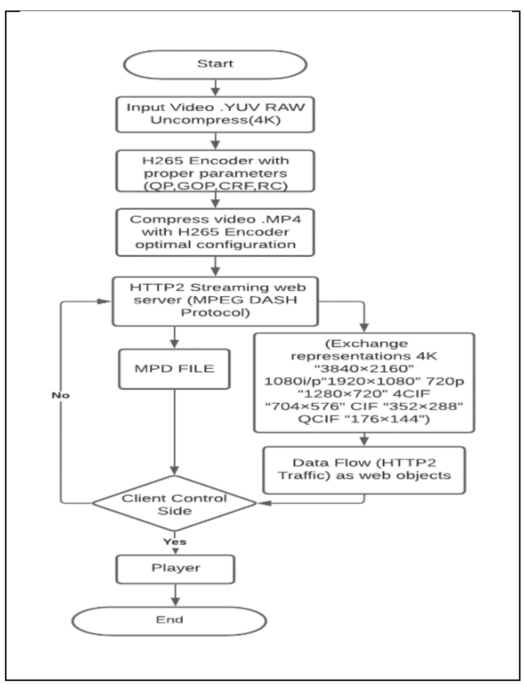


The video resolution target in this study is UHD (4K). The H.265 encoder parameters that affect BR and PSNR are used. The 4K (3840x2160) raw video is resampled into 1080i/p (1920x1080), 720p (1280x720), 4CIF (704x576), CIF (352x288) and QCIF (176x144) representations are encoded. Each representation is separated into temporal segments with a typical duration of 2 to 10 seconds [10]. Finally, a DASH client uses a rate adaptation algorithm to request each video segment based on a bandwidth prediction method, ensuring that the video quality matches the network performance [8, 18]. With the network technologies that have led to the video streaming services, the proposed system layout has made efficient video access to end-users with good quality and low latency. However, video requires the network quality of services but the networks suffer from packet loss, delay and jitter that led to degradation in video quality [13, 20].

2.1.Work Stage of the proposed low latency mpeg-dash system

The flowchart stages for the video source, HEVC/H.265 configuration and controller in the proposed system are shown in Figure 2.

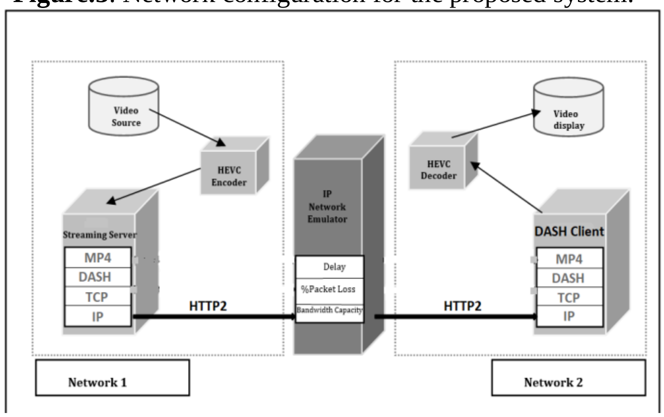
Figure.2. Flowchart of the proposed system model.



2.2.Network configuration for MEG-DASH system for video streaming

Efforts made by researchers is today at new smart devices and applications in transmitting multimedia data over IP network became very important. For these purposes, the MPEG DASH and its accompanying HTTP2 have now been developed to distribute multimedia content over the internet [14]. This research proposes that the MPEG DASH streaming protocol be used to provide real-time data transmission features with low latency and with control flow of data over the internet network. While the control is achieved by the MPEG DASH controller at the client-side that is used to give feedback to the streaming server about the network path status to allow this system to change the video representation according to network condition and send the suitable segment representation to the client to decoding and displaying. Both of their protocols support the availability of many-to-many communication, but for more scalability of applications, a one-to-many architecture of distribution is released that is used in this work with video multicasting. This work will use this approach to improve the scalability and performance of video streaming over the Internet by providing appropriate QoS feedback. Figure 3 illustrates the scenario of distributed video with Real-Time streaming over an IP network and the major parts of this experimental setup are the network test environment, the experimental methodology and a tool that had to be built to help analysis of the video content. Because the DASH is built on underlying protocols, it is used in this study to operate over TCP/IP [11]. After the encoding procedure, the resultant bitstream is packetized and sent over the network using the TCP transport protocol.

Figure.3. Network configuration for the proposed system.



As illustrated in Figure 3, the test environment includes a video streaming server in Network 1 and a client in Network 2. This system utilizes MPEG DASH for streaming and HTTP2 for transmission after determining a suitable video level using a controller at the client-side. While the player (Native Mpeg dash player) makes a request to the server for streaming video content, the server approves it and provides the video to the client through HTTP2. A network emulator tool is installed on the server to monitor the network route from the streaming server to the client and to simulate network parameter circumstances.

2.3.The Proposed video streaming system over IP network

To investigate overall network performance and its impact, coded videos are streamed over the Internet by combining encoder operation with network protocols. The video sources are of three classes of video content high details, medium details and low motion details, are used to evaluate the network performance and its parameters, such as channel bandwidth, packet loss, latency and delay jitter. Using the transport and streaming protocols “TCP”, “HTTP2” and “MPEG-DASH”, this mapping of information is used in the source-streaming server to provide the QoS of a multimedia distributed delivery system. The focus of this research is to observe the network performance influences video quality through its parameters on the path from source server to receiving clients. As a result of the rising need for broadband access technologies to transmit digital video, video has become more sophisticated due to the necessity for a huge amount of storage and transmission capacity. The network route condition from server to client is one of the most basic issues and it has an influence on video quality when it suffers from packet loss, latency, bandwidth congestion and delay jitter. This research focuses on how to transmit video with a low bit rate and low latency while accounting for network conditions.

3.Experimental Results and Simulation Test

3.1. H.265 Best Parameters Configuration Experiments

The software "FFMPEG" is used in this research to encode three test video sequences, Beauty, Bosphorus and ReadySetGo, while changing the parameters that affect bitrate and video quality in this investigation. PSNR is a video quality metric that can be used to observe and measure video quality. FFmpeg is a collection of libraries and tools for working with video, audio, subtitles, and metadata in multimedia files. This work uses libx265 and libavcodec, which provides a large number of codecs, as well as FFmpeg software package to, convert, handle and streaming video. Because of the wide range of devices used by users and the limited bandwidth available, video resolution and bitrate streaming must be adapted. FFmpeg program applies a layering of HEVC/H.265 compressed representations to raw video form utilizing the system parameters CRF, GOP, RC-LOOKAHEAD, and QP to produce a higher compression ratio according to the video's details. The following is a list of H.265 parameters:

(i) Quantization Parameter (QP) of HEVC:

The QP is validated using ranging of number 1, 5, 10, 15, 20, 25, 30, 35, 40, 45 and 51 to examine how well it works with their video test sequences and information from the six levels. Figures 4-6 show the outcomes of the three video sequences at six resolutions. The PSNR and Bitrate values decreased as the quantization parameter (QP) was increased.

Figure.4 Beauty video sequence and the variation of PSNR and Bitrate according to QP value with six resolutions.

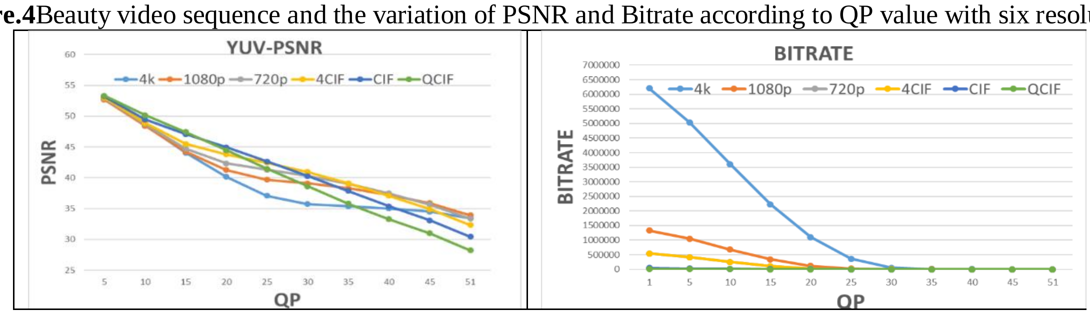


Figure.5 Bosphorus video sequence and the variation of PSNR and Bitrate according to QP value with six resolutions.

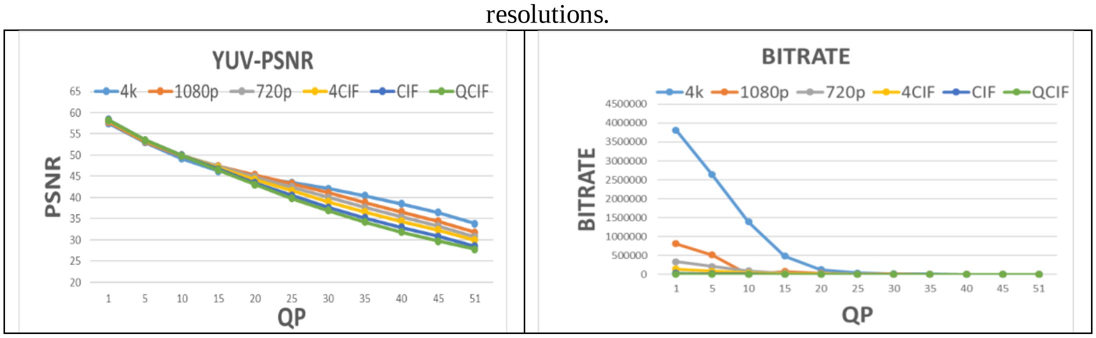
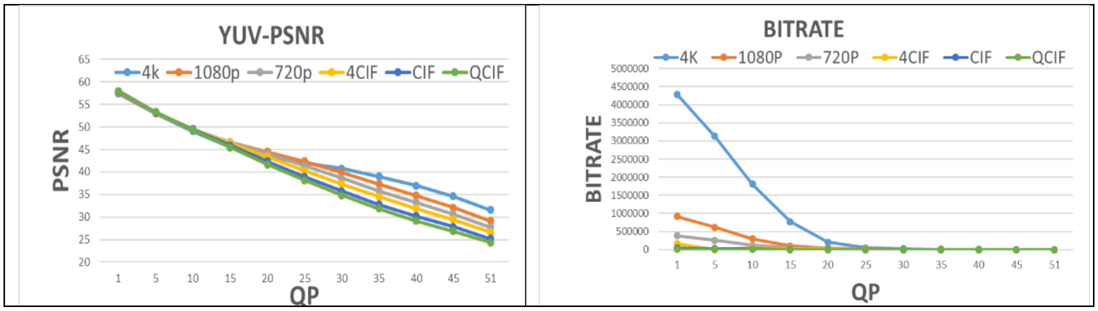


Figure.6 Readysetgo video sequence and the variation of PSNR and bit rate according to QP value with six resolutions.



(ii)RC lookahead (RC):

This parameter also utilizes in these experiments to find the best value. The range used in this work {5, 10, 15, 20, 25, 30, 40, 50 and 60}. Default 20 see Figures 7- 9.

Figure.7 Impact of RC-lookahead on video PSNR and Bitrate (Kbit/s) on six representation of the Beauty test sequence.

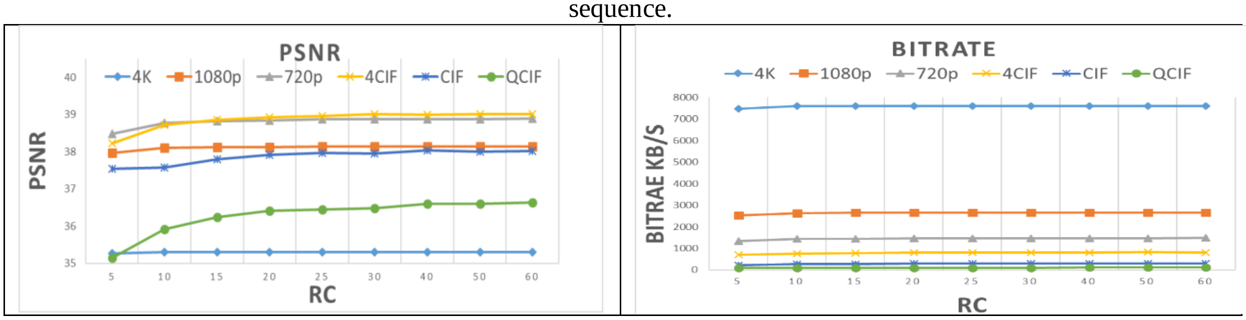


Figure.8 Impact of RC-lookahead on video PSNR and Bitrate (Kbit/s) on six representation of the Bosphorus test sequence.

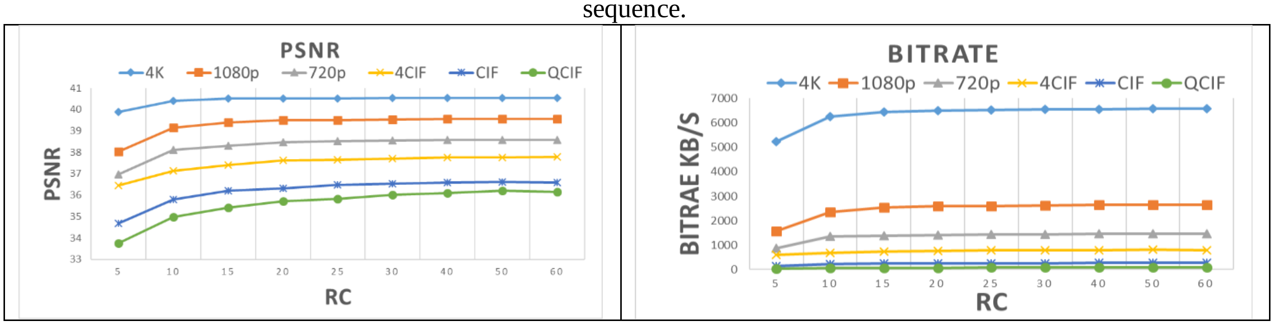
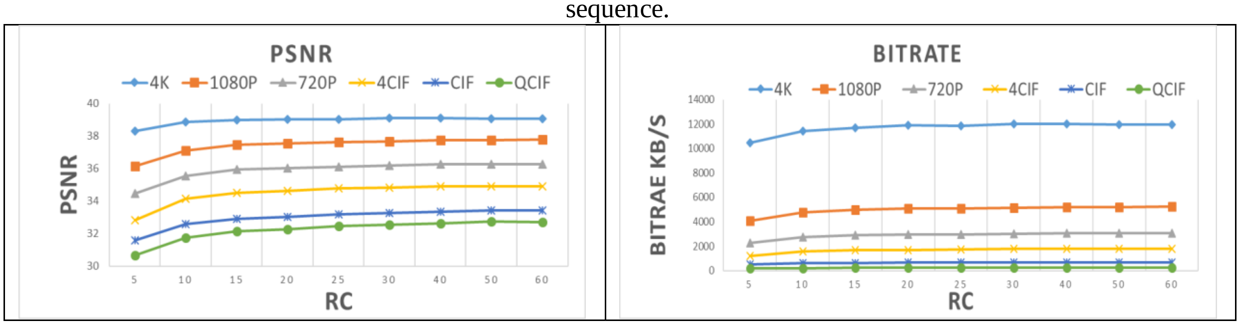


Figure.9 Impact of RC-lookahead on video PSNR and Bitrate (Kbit/s) on six representation of the ReadySetGo test sequence.



(iii)The Constant Rate Factor (CRF) of HEVC:

In this experiment, CRF values of 4, 12, 20, 28, 36, 44, and 51 were utilized and the results were compared to video before encoding (raw video). Tables 1- 6 show the outcomes for the three video with the six video layers. As the CRF value was increased, the PSNR and BR values decreased.

Table.1. CRF influenceon videoqualityand bitrate (KBIT/S) on 3840x2160 resolution

Video Sequence	Beauty			Bosphours			Readysetgo		
CRF	**PSNR**	**BR(Kbit/s)**	**Time**	**PSNR**	**BR(Kbit/s)**	**Time**	**PSNR**	**BR(Kbit/s)**	**Time**
4	47.008	3238779	150.22	48.459	1177332	99.87	47.862	1486195	103.34
12	40.307	1247564	119.55	44.927	175312	39.48	43.534	268984	43.83
20	36.083	151203	43.43	43.007	27664	18.51	41.588	36455	19
28	35.294	7603.68	13.64	40.521	6527.26	14.6	39.027	11864.61	13.85
36	34.425	2333.17	11.08	37.285	1877.57	15.61	35.451	4216.34	12
44	33.024	856.03	8.61	33.604	657.01	11.09	31.353	1709.83	9.47
51	31.841	780.96	8.29	31.557	471.15	7.65	28.818	1159.22	8.25

Video Sequence	Beauty			Bosphours			Readysetgo		
CRF	**PSNR**	**BR(Kbit/s)**	**Time**	**PSNR**	**BR(Kbit/s)**	**Time**	**PSNR**	**BR(Kbit/s)**	**Time**
4	47.378	609945.62	32.38	49.544	201422.2	15.68	48.308	225697.58	13.98
12	41.568	152660.27	19.08	46.286	41263.02	7.1	44.977	46407.81	6.27
20	39.331	10198.77	5.44	43.144	9979.75	4.23	41.658	14014.02	4.08
28	38.119	2662.01	3.47	39.493	2608.99	2.73	37.535	5031.48	3.04
36	36.085	786.14	2.57	35.753	725	2.24	33.222	1664.77	2.45
44	33.468	288.98	2.22	31.971	231.88	2.08	29.249	595.61	2.15
51	31.51	244.58	2.27	30.041	146.36	1.96	28.849	351.66	2.02

Table.2.CRF influence on video quality and bitrate (KBIT/S) on 1920x1080 resolution

Table.3.CRF influence on video quality and bitrate (KBIT/S) on 1280x720 resolution

Video Sequence	Beauty			Bosphours			Readysetgo		
CRF	**PSNR**	**BR(Kbit/s)**	**Time**	**PSNR**	**BR(Kbit/s)**	**Time**	**PSNR**	**BR(Kbit/s)**	**Time**
4	47.642	221353	13.57	49.684	81882.63	6.32	48.451	91344.84	5.96
12	42.604	39910.39	6.47	46.116	20573.12	3.45	44.729	25745.46	3.46
20	40.82	4629.04	2.57	42.415	5377.41	1.99	40.528	8662.71	2.43
28	38.843	1452.45	1.75	38.453	1418.26	1.23	36.015	2939.51	1.75
36	36.025	442.18	1.21	34.673	385.89	1.04	31.715	911.11	1.23
44	33.14	157.42	0.96	31.139	124.3	0.89	27.913	305.58	1.04
51	30.997	123.72	0.91	29.195	83.1	0.91	25.695	173.58	0.93

Video Sequence	Beauty			Bosphours			Readysetgo		
CRF	**PSNR**	**BR(Kbit/s)**	**Time**	**PSNR**	**BR(Kbit/s)**	**Time**	**PSNR**	**BR(Kbit/s)**	**Time**
4	47.965	70837.38	5.53	49.907	34764.53	3.07	48.474	43235.62	3.2
12	43.985	10335.43	2.49	45.946	10389.32	1.74	44.075	15284.82	2.14
20	41.794	2532.04	1.52	41.799	2900.87	1.01	39.322	5323.58	1.46

28	38.92	805.26	1.02	37.627	767.75	0.72	34.643	1699.82	1
36	35.684	239.72	1.39	33.911	207.3	0.64	30.471	497.45	0.71
44	32.336	89.71	0.64	30.542	69.26	0.6	26.812	155.68	0.62
51	30.099	69.24	0.6	28.598	48.5	0.59	24.73	88.9	0.58

Table.4. CRF influence on video quality and bitrate (KBIT/S) on 704x576 resolution

Table.5. CRF influence on video quality and bitrate (KBIT/S) on 352x288 resolution

Video Sequence	Beauty			Bosphours			Readysetgo		
CRF	**PSNR**	**BR(Kbit/s)**	**Time**	**PSNR**	**BR(Kbit/s)**	**Time**	**PSNR**	**BR(Kbit/s)**	**Time**
4	48.9	11162.45	1.58	50.22	9095.98	1.2	48.318	14388.11	1.38
12	45.411	2769.82	0.85	45.778	3150.61	0.73	43.097	6025.58	0.97
20	41.776	909.48	0.6	41.02	962.46	0.45	37.849	2167.55	0.65
28	37.927	287.83	0.39	36.321	357.19	0.27	33.042	642.59	0.39
36	34.15	97.83	0.27	32.617	74.13	0.21	28.953	176.36	0.25
44	30.561	41.82	0.21	29.196	32.46	0.21	25.476	53.52	0.21
51	28.258	31.32	0.2	27.676	25.02	0.19	23.604	38.59	0.19

Video Sequence	Beauty			Bosphours			Readysetgo		
CRF	**PSNR**	**BR(Kbit/s)**	**Time**	**PSNR**	**BR(Kbit/s)**	**Time**	**PSNR**	**BR(Kbit/s)**	**Time**
4	49.558	2302.88	0.47	50.498	2097.7	0.65	48.216	4619.81	0.63
12	45.185	879.35	0.65	45.894	806.62	0.29	42.599	2054.84	0.45
20	40.68	310.08	0.23	40.659	268.39	0.19	37.156	765.95	0.3
28	36.456	105.8	0.16	35.699	79.88	0.12	32.311	233.71	0.18
36	32.533	43.69	0.11	31.661	32.23	0.1	28.181	66.34	0.12
44	28.61	24.04	0.1	28.527	19.27	0.09	24.7	25.18	0.08
51	26.489	18.83	0.09	26.631	17.75	0.08	23.108	21.22	0.09

Table.6. CRF influence on video quality and bitrate (KBIT/S) on 176x144 resolution

(iv)The Group of Pictures (GOP) of HEVC:

Using the tool -FFMPEG, encode and decode each sequence using the H.265/HEVC compression standard. The target bitrate is set to a range of 2Mbps to 10Mbps, with 1Mbps increments. The GOP pattern is determined by the coding structures listed in Table 7, which include five GOP sizes and three B-frame numbers. The outcomes are shown in Figure 10-12

Table.7.five GOP sizes and three B-frames

GOP (group of picture) size	B-frame numbers
4	2
8	2
16	2
24	2
16	4
16	8

Figure.10 For the "Beauty" test sequences, the evaluation outcomes with various GOP structures and B-frame patterns.

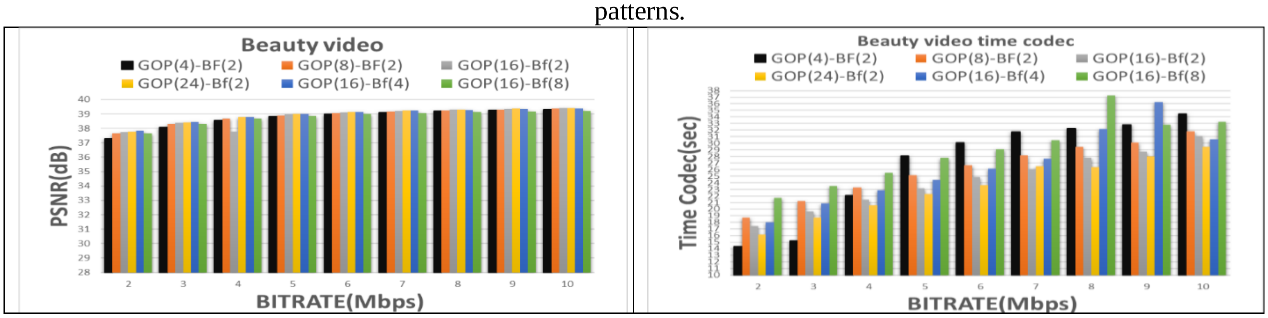


Figure.11 For the "Bosphorus" test sequences, the evaluation outcomes with various GOP structures and B-frame patterns.

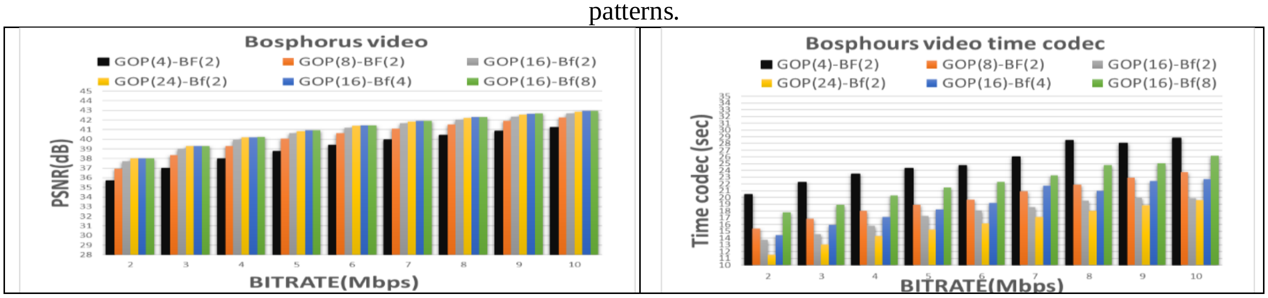
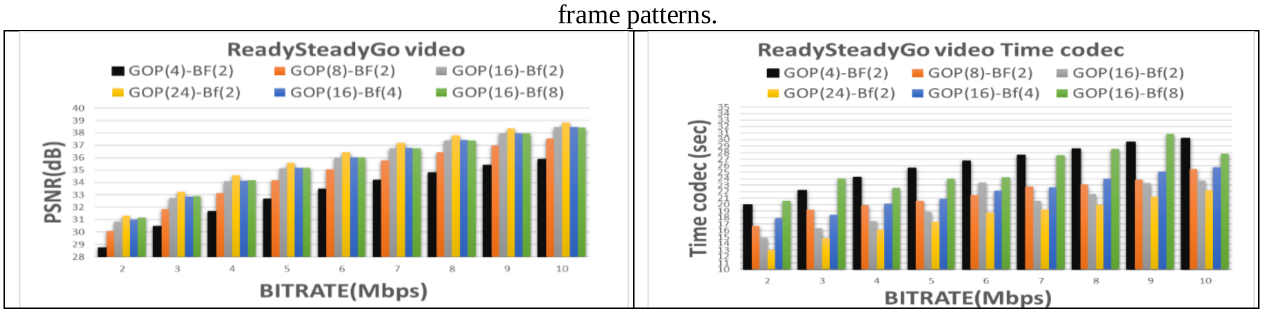


Figure.12 For the "Readysetgo" test sequences, the evaluation outcomes with various GOP structures and B-frame patterns.



3.2. Discussion of Additional Encoding Results

The experiments lead us tofind the best range of each resolution maintains satisfactory video quality at (32-40) dB. Tables 8, 9 and 10 provide the required PSNR (36 dB) of appropriate parameter choices. For adaptive streaming at the same resolution QP is a significant parameter while maintaining of the others. Table 11 shows the net compression ratio for each video sequence with all layers measured at PSNR 36 dB, which reflects the encoder bit rate that will be streamed.

Layer	RC	GOP	QP	Before HEVC bitrate Kbit/s	After HEVC bitrate Kbit/s	PSNR	Time encode(s)	CR
4K	20	100	26	11943936	3692.01	36.671	45.72	3235.08
1080i/ p	20	100	41	2985984	1189.4	36.996	2.75	2510.58
720p	20	100	42	1327104	539.91	36.776	1.32	2458.01
4CIF	20	100	41	583925	338.57	36.672	0.81	1724.6
CIF	20	100	37	145981	215.35	36.833	0.4	677.87
QCIF	20	100	33	36495	135.81	36.929	0.2	268.72

Table.8. best setting parameters of HEVC for Beauty video sequence with six layers

Table.9. best setting parameters of HEVC for Bosphorus video sequence with six layers

Layer	RC	GOP	QP	Before HEVC bitrate Kbit/s	After HEVC bitrate Kbit/s	PSNR	Time encode(s)	CR
4K	20	100	45	11943936	1289.1	36.459	8.51	9265.32
1080i/ p	20	100	40	2985984	923.3	36.626	2.29	3234.03
720p	20	100	37	1327104	765.79	36.701	1.1	17337.8
4CIF	20	100	35	583925	525.43	36.588	0.68	1111.32
CIF	20	100	32	145981	264.83	36.558	0.34	551.22
QCIF	20	100	30	36495	105.45	36.938	0.2	346.08

Table.10. best setting parameters of HEVC for Readysetgo video sequence with six layers

Layer	RC	GOP	QP	Before HEVC bitrate Kbit/s	After HEVC bitrate Kbit/s	PSNR	Time encode(s)	CR
4K	20	100	40	11943936	6727.5	36.994	11.73	1775.38
1080i/ p	20	100	36	2985984	4704.2	36.814	3.03	634.74
720p	20	100	33	1327104	4181.9	36.966	1.93	317.34
4CIF	20	100	31	583925	3290.8	36.769	1.23	177.44
CIF	20	100	28	145981	1986.7	36.998	0.61	73.47
QCIF	20	100	27	36495	784.24	36.751	0.29	46.53

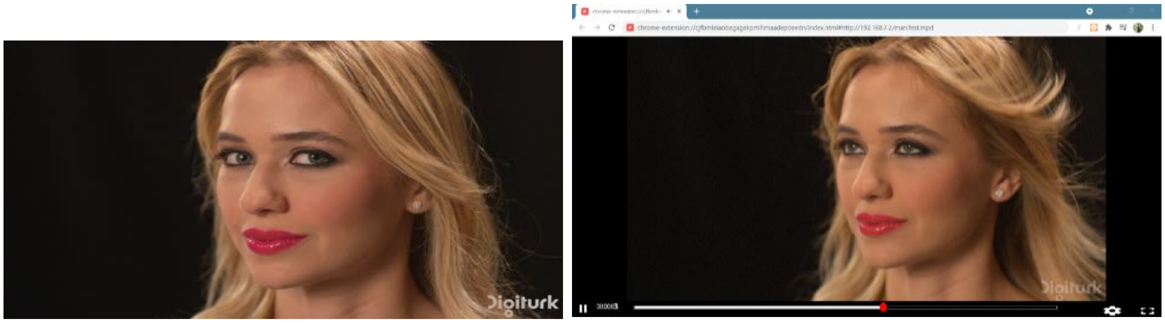
Table.11. the compression ratio of three video test sequences with acceptable PSNR for six layers.

Video Sequence	Beauty		Bosphours		Readysetgo	
layer	**PSNR**	**CR**	**PSNR**	**CR**	**PSNR (dB)**	**CR**
4K	36.651	3235.08	36.459	9265.32	36.994	1775.4
HD	36.996	2510.58	36.626	3234.03	36.814	634.74
720p	36.776	2458.009	36.701	17337.78	36.966	317.34
4CIF	36.672	1724.6	36.588	1111.32	36.769	177.44
CIF	36.833	677.87	36.558	551.22	36.998	73.47
QCIF	36.929	268.72	36.938	346.08	36.751	46.53

3.3 MPEG-DASH Streaming Server Configuration

At the webserver, NGINX software that supports HTTP2 protocol is installed as well as FFmpeg package software is installed, where FFmpeg software is used to create multiple layers/resolutions. The GPAC software is installed at the server to create a DASH file with multiple representations and create an MPD XML file for these representations. When a client requests a video, the MPD provides different information about all these representations of the video by using the Native MPEG dash player to get the video sequence from the streaming server. The streaming server sends the video sequence to the client and displays it on the native Mpeg dash player by typing the URL in the textbox of the player with Google Chrome browser “http://192.168.1.4/manifest.mpd”. When the channel is bad, the controller at the client-side selects proper representation. The player put on auto to automatically displaying proper representation and also you can put the player at client-side on the representation of what you want but will cause rebuffering and stopping display video if the channel is bad. The streaming server also installs a PRTG network monitor on the streaming server to evaluate network performance. Such system layout is tested where the client-received video is shown in Figure 13.

Figure.13(a) Source video, (b) Client video with a Native Mpeg dash player.



(a) (b)

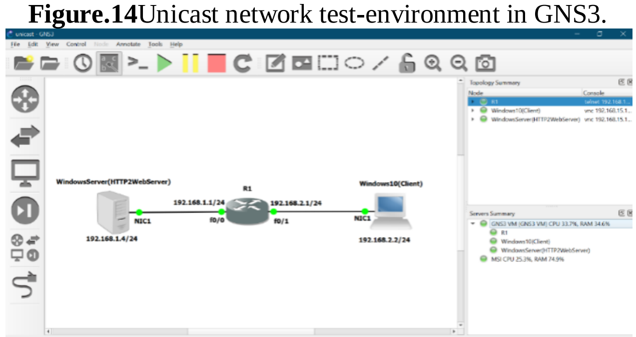
3.4 Performance Evaluation of Video Streaming over an IP Network

To send the test video sequences utilized in the previous sections, many experiments are performed. Both unicasting and multicasting network use the encoded videos at multiple layers of resolution while the PRTG network-monitoring tool is used for traffic monitoring installed on the streaming server.

(i) Video Sequence Delivery with Unicasting Network Topology

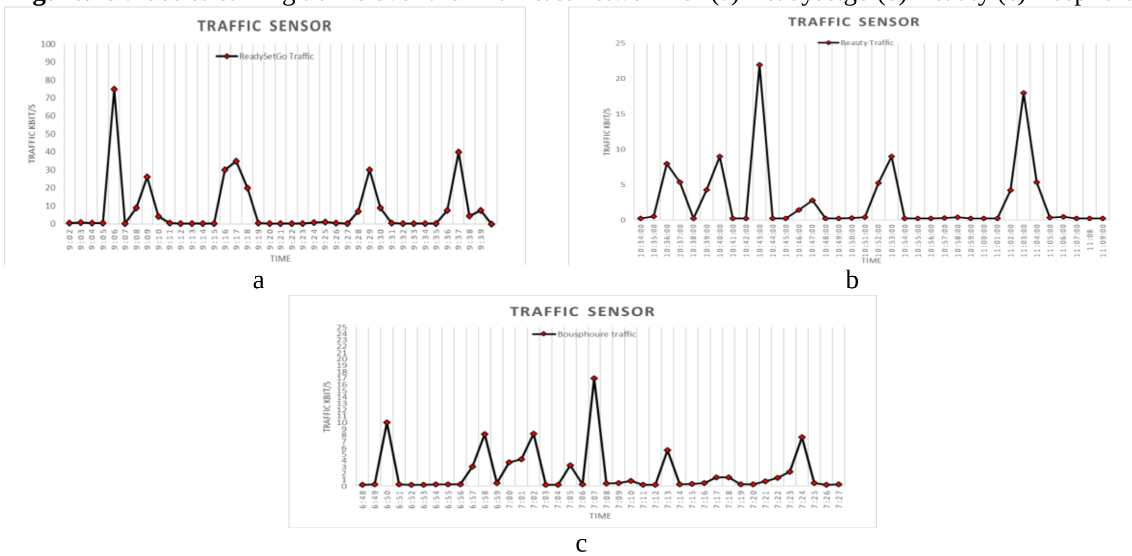
This simulation is generally designed to look at the different effects of network factors on video streaming characteristics when the video is transferred from the streaming server to the client via the IP Network shown in Figure 14.

Figure.14 Unicast network test-environment in GNS3.



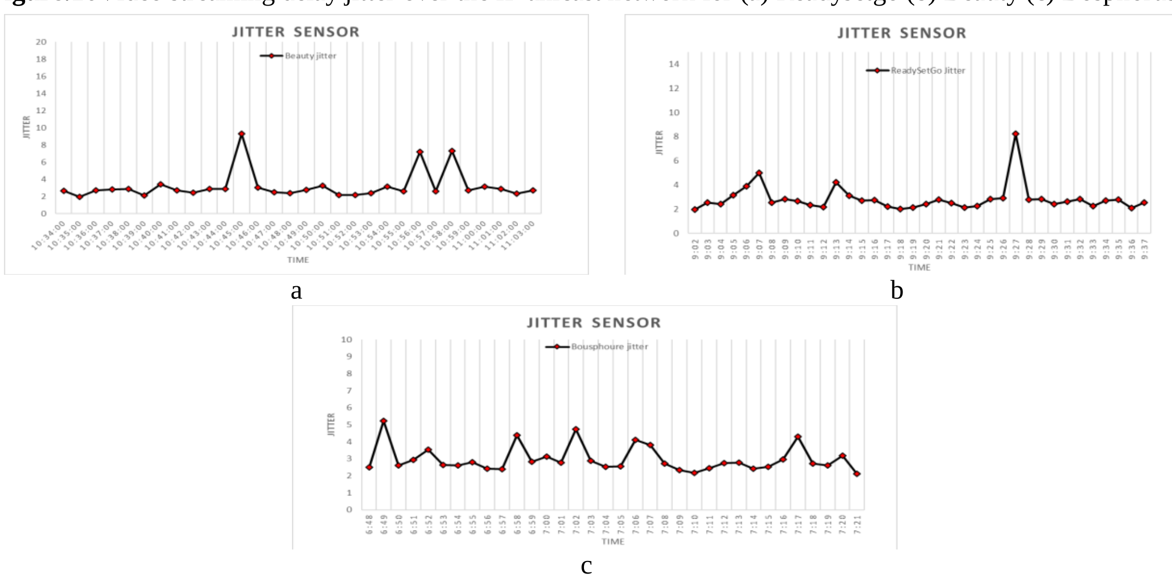
The Ethernet sensor is used in unicasting video streaming to report the results of data transmitted over this route and to illustrate how available bandwidth varies with changing video resolutions, whereas the ping jitter sensor and the ping sensor are used to monitor the degree of delay jitter and latency. The results of the bandwidth available for the Ethernet traffic sensor are shown in Figure15.

Figure.15 Video streaming traffic over the IP unicast network for (a) Readysetgo (b) Beauty (c) Bosphorus.



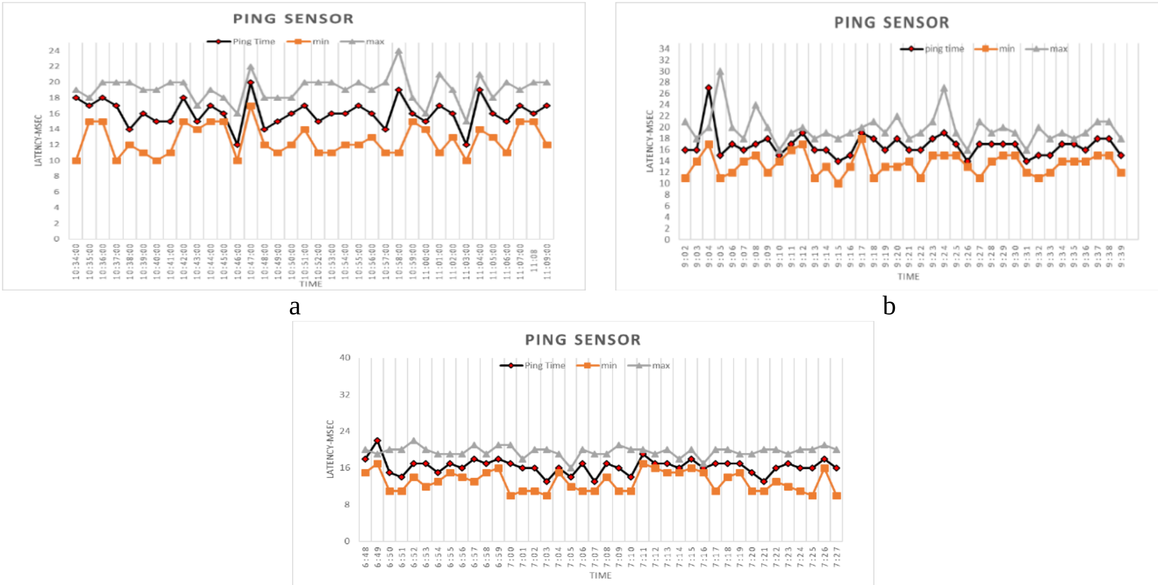
The results of a delay jitter on the ping Jitter sensor are shown in Figure 16.

Figure.16 Video streaming delay jitter over the IP unicast network for (a) Readysetgo (b) Beauty (c) Bosphorus.



The results of a delayed latency on the ping sensor are shown in Figure 17.

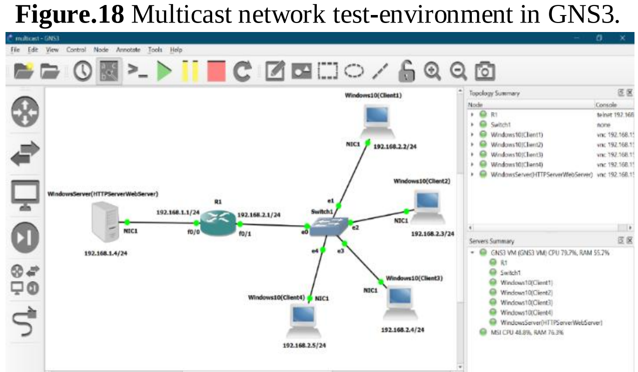
Figure.17 Video streaming delay latency over the IP unicast network for (a) Readysetgo (b) Beauty (c) Bosphorus.



(ii) Video Sequence Delivery with Multicasting Network Topology

This simulation is generally designed to look at the impact of network factors on video streaming characteristics from the streaming server to multiple users. In this multicasting network environment, four clients get video streaming from the server via IP Network, as shown in Figure 18.

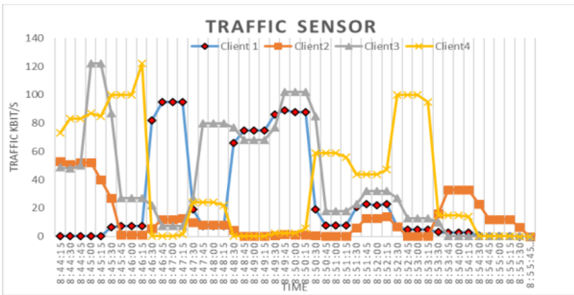
Figure.18 Multicast network test-environment in GNS3.

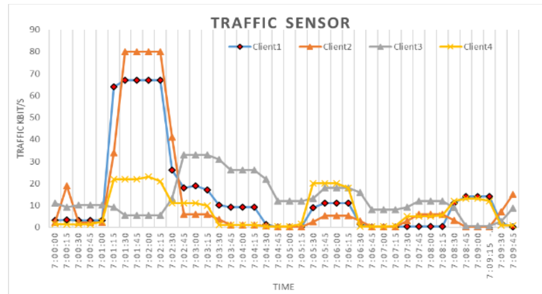


The three types of motion details for their test sequences behave differently, with high motion details suffering from packet loss, latency and delay jitter more than the other two classes of video, implying that a poor network has a greater negative impact on this type of video. Figure 19 shows network traffic when the video sequences are shared across four clients at once, while Figures 21 shows the results of the delay jitter of streaming the Readysetgo, the Beauty and Bosphorus sequences. The PRTG sensors are used in this study to monitor delay, jitter and latency, which are all enhanced as a result of multicasting video streaming among clients. When sending video over the Internet, these factors have an impact on video quality, especially when the spatial resolution and motion details are high.

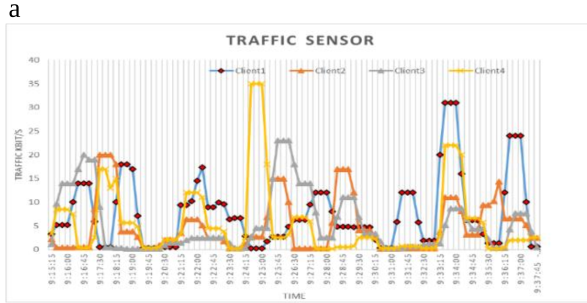
Figure 19 illustrates the results of the bandwidth availability test for the Ethernet traffic sensor of multicast topology.

Figure.19 Traffic for video streaming with four clients for (a) Readysetgo (b) Beauty(c) the Bosphorus.



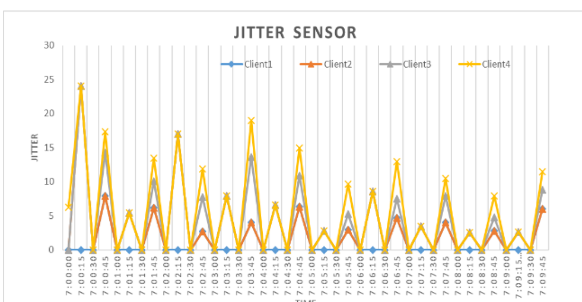


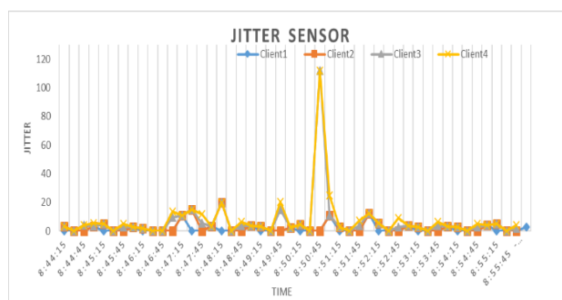
a b



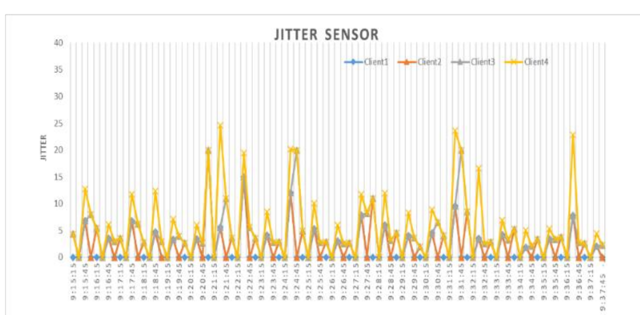
c

Figure.20 Video streaming delay jitter of four clients for (a) Readysetgo (b) Beauty (c) Bosphorus.





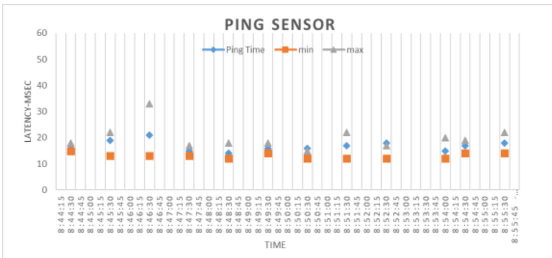
a b



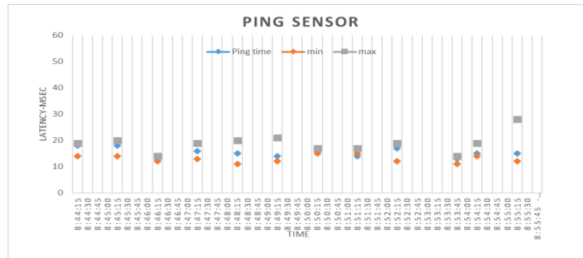
c

The ping sensor results of delay latency are shown in Figures 21.

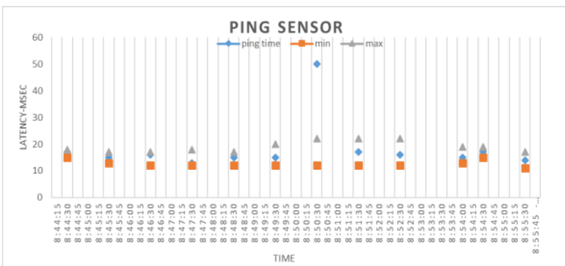
Figure.21 The four clients of Readysetgo video streaming delay latency.



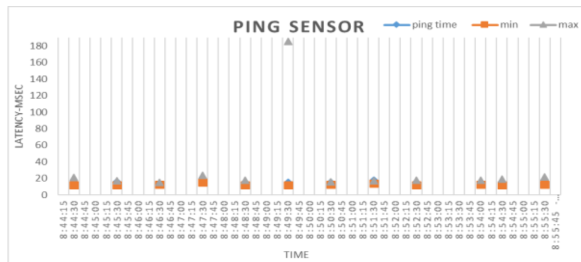
Client1



Client2

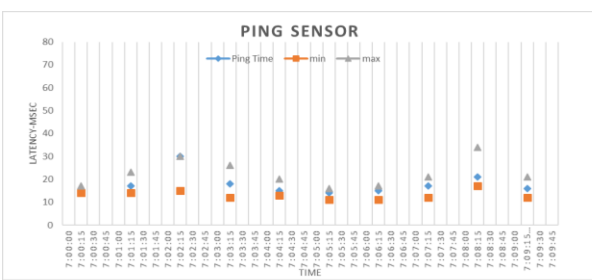


Client3

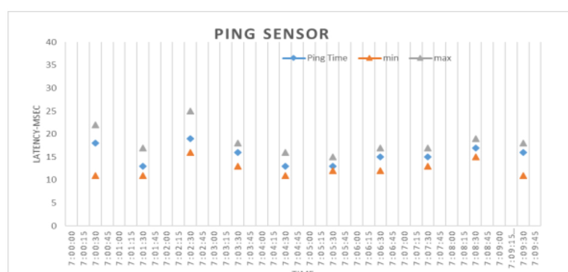


Client4

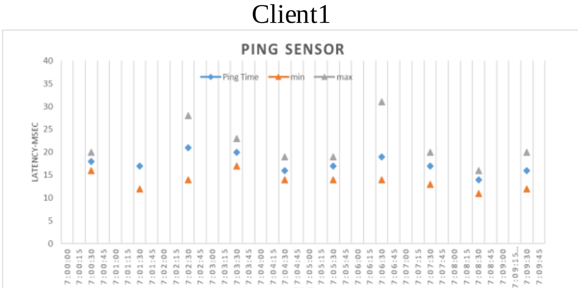
Figure.22 The four clients of Beauty video streaming delay latency.



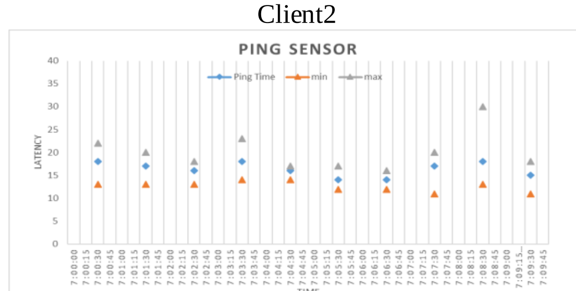
Client1



Client2



Client3



Client4

Figure.23 The four clients of Bosphorus video streaming delay latency.

Client1 Client2

Client3 Client4

4. Conclusion

Based on the practical results of implementing the proposed video streaming system over the Internet network and measurement approaches, several results have been obtained. As the number of users on the network grows, the goal of this study is to adapt high-quality video streaming over the Internet network with minimum latency while sending to clients due to bandwidth limitations and the effect of network parameters. The solution to the problem is divided into encoder/decoder layout design; where the encoder side is of video encoding and control streaming while the decoder is of video proper resolution displaying and network sensing. The encoder selects the proper resolution based to the decoder request beside the adaptively segment length streaming based to the decoder instruction.

References

1. Cisco, “Cisco visual networking index: Global mobile data traffic forecast update”, 2017–2022 white paper, USA, December 2017.

2. N. Angelescu (2015). Objective video quality assessment: using H264 and H.265 codecs for 4K transmissions. Scientific Bulletin of the Electrical Engineering Faculty, No. 1(29).

3. M. P. Sharabayko, O. G. Ponomarev and R. I. Chernyak (2013). Intra compression efficiency in VP9 and HEVC. Applied Mathematical Sciences, Vol. 7, No. 137, pp. 6803-6824.

4. Koeppel Direct Blog, Peter Koeppel,” rise of live streaming: Trends and marketing tips”, USA, June 2017.

5. J. Vlaović, S. Rimac-Drlje, F. Vranješ and R. P. Kovač (2019).Evaluation of Adaptive Bitrate Selection Algorithms for MPEG DASH.2019 International Symposium ELMAR, pp. 73-76.

6. M. Dabrowski, R. Kolodynski, and W. Zielinski (2015). Analysis of video delay in internet TV service over adaptive HTTP streaming. In Position Papers of the Federated Conference on Computer Science and Information Systems (FedCSIS), Poland.

7. Y. Zhao, X. Gong, W. Wang and X. Que(2012).A rate adaptive algorithm for HTTP streaming.2012 IEEE 2nd International Conference on Cloud Computing and Intelligence Systems, VOL.02, pp. 529-532, China.

8. K. Doh Kwan, B. Jinsuk and F. Paul (2014).Adaptive video streaming over HTTP. 2014 ACM Southeast Regional Conference, Southeast.

9. G. J. Sullivan, J. Ohm, W. Han and T. Wiegand(2012) .Overview of the High Efficiency Video Coding (HEVC) Standard.in IEEE Transactions on Circuits and Systems for Video Technology, vol. 22, no. 12, pp. 1649-1668.

10. S. Lederer, C. Müller and C. Timmerer (2012). Dynamic adaptive streaming over http dataset.In Proceedings of the 3rd Multimedia Systems Conference (ACM SIGMM).

11. Kim, D., Baek, J., Fisher, P., (2014).Adaptive video streaming over HTTP.Proceedings of the 2014 ACM Southeast Regional Conference on - ACM SE.

12. M. Uhrina, J. Frnda, L. Sevcik and M. Vaculik (2014). Impact of H. 264/AVC and H. 265/HEVC compression standards on the video quality for 4K resolution.2014 Advances in Electrical and Electronic Engineering, VOL. 12, NO. 4.

13. L. Anegekuh, L. Sun, E. Jammeh, I.-H. Mkwawa and E. Ifeachor (2015). Content-based video quality prediction for HEVC encoded videos streamed over packet networks. IEEE Transactions on Multimedia, VOL. 17, NO. 8, pp. 1323-1334.

14. J. J. Quinlan, A. H. Zahran and C. J. Sreenan (2016). Datasets for AVC (H. 264) and HEVC (H.265) Evaluationof Dynamic Adaptive Streaming over HTTP (DASH).Proceedings of the 7th International Conference on Multimedia Systems.

15. Duc, Nguyen & Le, Hung & Pham Ngoc, Nam & Pham, Anh& Cong Thang, Truong. (2016). Adaptation Method for Video Streaming over HTTP/2. IEICE Communications Express. 5. 10.1587/comex.2015XBL0177.

16. Y. SAKAMOTO, R. YOKOYAMA, M. TAKEUCHI, Y. MATSUO and J. KATTO (2019). Improvement of H.265/HEVC Encoding for 8K UHDTV by GOP Size and Prediction Mode Selection. 2019 IEEE International Conference on Consumer Electronics (ICCE), pp. 1-2, USA.

17. T. Wiegand, G. J. Sullivan, G. Bjøntegaard, and A. Luthra (2003). Overview of the H.264/AVC video coding standard. IEEE Trans. Circuits Syst. Video Techn, 13(7):560–576.

18. ISO, “Dynamic adaptive streaming over http (dash)”, Technical Report 23009-1, Edition 1, ISO/IEC, USA, 2012.

19. M. Belshe, R. Peon and M. Thomson (2015). Hypertext transfer protocol version 2 (http/2) standard. Technical Report RFC-7540, IETF.

20. M. Uhrina, J. Hlubik and M. Vaculik (2012). Correlation between objective and subjective methods used for video quality evaluation.2012 ELEKTRO, pp. 103-108, Slovakia.

21. J. Frnda, M. Voznak and L. Sevcik (2015).Impact of packet loss and delay variation on the quality of real-time video streaming. Telecommunication Systems, VOL 62, Issue 2, pp. 265-275, USA.